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ABSTRACT

Presented is an investigation of the item and factor characteristics which make up Forms 8, 9, and 10 of the Armed Services Vocational Aptitude Battery (ASVAB). Data on the ASVAB forms were collected from mulitary enlistment applications at 20 Armed Forces Examining and Entrance Stations. Item and factor analyses were conducted on samples equated in ability through the Armed Forces Qualification Test-7a. The true score theory item analyses show the subtests to have relatively easy items in most cases. Item-test biserial correlations are quite high (about .60), indicating subtest internal consistency. In keeping with these indexes, the subtest means are high, and distributions of raw scores are skewed toward the easy range. Subtest scores have high reliability as befits homogeneous groups of items. Item response theory analyses show much the same information with easy items. Test information curves are generally unimodal and skewed toward lower ability subjects. Average item information is good. The factor analyses show the six forms to be quite similar to each other and to previous ASVAB forms. Solutions with the four factors labeled Verbal, Mathematical, Vocational Information, and Clerical Speed showed a median intercorrelation of .51 with a limited range. (Author/PN)

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AIR FORCE HUMAN RESOURCES LABORATORY

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ARMED SERVICES VOCATIONAL APTITUDE BATTERY: ITEM AND FACTOR ANALYSES OF FORMS 8, 9, AND 10

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This study presents an investigation of the characteristics of the items and factors which make up Forms 8, 9, and 10 of the Armed Services Vocational Aptitude Battery (ASVAB).

Data on the ASVAB forms were collected from a large sample of applicants for military enlistment at 20 geographically dispersed Armed Forces Examining and Entrance Stations (AFEES). Item and factor analyses were conducted on samples equated in ability through an external reference test, the Armed Forces Qualification Test-7a (AFQT-7a).

Item 20 Continued:

The true score theory item analyses show the subtests to have relatively easy items in most cases. Item-test biserial correlations are quite high (about .60), indicating subtest internal consistency. In keeping with these indexes, the subtest means are high, and distributions of raw scores are skewed toward the easy range. Subtest scores have high reliability as befits homogeneous groups of items.

Item response theory analyses show much the same information with easy items. Test information curves are generally unimodal and skewed toward lower ability subjects. Average item information is quite good.

The factor analyses show the six forms to be quite similar to each other and to previous ASVAB forms. Solutions with the four factors labeled Verbal, Mathematical, Vocational Information, and Clerical Speed showed a median intercorrelation of .51 with a limited range.

PREFACE

This is the second in a series of reports on Forms 8, 9, and 10 of the Armed Services Vocational Aptitude Battery (ASVAB). This study was completed under the auspices of Personnel Qualifications, which is part of a larger effort in Force Acquisition and Distribution. It was subsumed under project number 77191804, "Maintenance and Improvement of Enlistment Selection and Classification Tests," and was executed as part of the Air Force Human Resources Laboratory's responsibility as lead laboratory under the executive agent (USAF) for ASVAB research and development.

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ARMED SERVICES VOCATIONAL APTITUDE BATTERY: ITEM AND FACTOR ANALYSES OF FORMS 8, 9, AND 10

I. INTRODUCTION

The Air Force Human Resources Laboratory is the lead laboratory for research and development (R&D) in support of the Armed Services Vocational Aptitude Battery (ASVAB). The ASVAB is used for selection and classification of enlistees for the four branches of the Armed Services.

This battery is routinely revised in order to minimize test compromise, to replace obsolete items, and to make improvements based on recent information concerning validity and psychometric advances. ASVAB Forms 8, 9, and 10 became operational in October 1980, replacing Forms 6 and 7. The new forms are comprised of 10 subtests, eight of which are power subtests, and two of which are speeded. There are six distinct current ASVAB forms: 8a, 8b, 9a, 9b, 10a, and 10b. Each form contains four unique sets of items for the subtests included in the Armed Forces Qualification Test (AFQT) composite. The AFQT subtests are Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension, and Numerical Operations. For the remaining subtests, only three unique item sets exist, one each for Forms 8, 9, and 10. There are three sets of unique items for the Mechanical Comprehension, Mathematics Knowledge, Coding Speed, Auto-Shop Information, Electronics Information, and General Science subtests. For example, 8a and 8b versions contain the same items for these six subtests. The order of items is scrambled within each subtest.

Item selection for ASVAB forms 8, 9, and 10 utilized unpublished data on high school students. The characteristics of the items and test factors should be investigated based on operational information. The objective of this study is to describe the psychometric characteristics of ASVAB forms 8, 9, and 10. This report should become a reference for future ASVAB-related R&D efforts.

Two of the most frequent methods of understanding the structure of a test are through the use of item analysis and factor analysis. Frequently, item characteristics and intended factor structure are specified by test constructors in order to build tests with desired characteristics.

Item analyses provide information about specific items or aggregates of items. This information is used to select and classify items, accept or reject items, and modify items. Factor analysis is a more global procedure for identifying structural components of a set of variables; in this case, test subscale scores. It is used frequently to search for structure or to confirm whether a particular structure exists.

II. METHOD

Subjects and Group Formation

Test responses were collected from a sample of 19,359 applicants for enlistment in the military at 20 Armed Forces Examining and Entrance Stations (AFEES). AFEES were selected on the basis of applicant flow and national representativeness. Each applicant took one form of the ASVAB and the Armed Forces Qualification Test-Form 7a (AFQT-7a) in counterbalanced fashion. Extensive data editing to validate the accuracy of answer sheet coding was performed and is documented elsewhere (see Ree, Mathews, Mullins, & Massey, 1981).

Ability tests used for military selection and classification are usually referenced to the 1944 mobilization base of males. Female applicants were deleted from the current sample, and the remaining male sample was weighted to produce a rectilinear distribution of scores on the AFQT-7a, an earlier form of AFQT, which was normed on males and is no longer operational. This produces a sample with an ability distribution quite similar to that found in the 1944 mobilization base. Thus general comparisons with previous analyses may be made. Table 1 shows the number of subjects by ASVAB form administered. Positive weights were used for the factor analyses, while random deletion and duplication of subjects was used for the item analyses. The random deletion and duplication procedure, while not as desirable as weights, accomplishes the weighting and permits the use of existing item analytic software. Although its efficacy is unknown, this latter procedure for the IRT analyses was used since no procedure for weighted IRT item analysis exists.

Table 1. **Number of Subjects by ASVAB Form**

Form	Number of Subjects
8a	2,620
8b	2,510
9a	2,590
9b	2,500
10a	2,480
10b	2,420

Item Analysis

For purposes of this study, two types of item analyses were used. The first was the well known classical or "true score" theory statistics of difficulty and discrimination. Gulliksen (1950) and others (see Davis, 1951; Henrysson, 1971) offer detailed descriptions of the merits and drawbacks of these procedures. Also used were the more modern Item Response Theory (IRT) item analytic indexes (Lord & Novick, 1968) based on the Birnbaum (1968) three-parameter logistic model. These three parameters are a (item discrimination), b (item difficulty), and c (probability of guessing) (see Ree, 1979, for a detailed description of these item parameters). Both types of analyses were completed in order to describe fully the items and provide information useful at both simple and sophisticated levels.

Classical analyses performed on the power subtests of each form included computation of item difficulties, item standard deviations, and item correlations with total subtest score. Additionally, the subtest scores were analyzed to provide estimates of their first four moments (means, variances, skew, and kurtosis) and reliability. Speeded tests were analyzed by investigating the first four moments of their score distributions and pattern of omitted responses.

Item Response Theory analyses were conducted in accordance with past experience (Ree, 1979) for the power tests only. A local modification to Urry's OGIVIA procedure (Gugel, Schmidt, & Urry, 1976) was used. The modifications affect only input, output, and item-linking and do not affect estimation procedures. No procedure for speeded tests exists which does not violate the unidimensionality assumption of Item Response Theory. Test information curves (see Birnbaum, 1968) were computed for each power subtest in each form.

Factor Analysis

Previous forms of the ASVAB have been subjected to factor analyses to search for structure (Fletcher & Ree, 1976; Sims & Mifflin, 1978) or to develop composites for measurement of particular abilities (Fischl, Ross, & McBride, 1977). In at least two prior analyses, the verbal, clerical speed, quantitative, and technical information factors have been extracted from the previous set of ASVAB forms. The current effort was confirmatory in nature.

There are many procedures which can constitute a factor analysis. There are no wrong procedures, just procedures that are more or less desirable. In the past, ASVAB has usually been factor analyzed at the subtest level (Fischl, Ross, & McBride, 1977; Fletcher & Ree, 1976). The current study used this procedure and factored the test with scores from the AFQT-7a as a reference. AFQT-7a was the test to which the ASVAB composites were equated (Ree, Mathews, Mullins, & Massey, 1981). The principal components of the matrix were factored using the traditional squared multiple correlations (smc) in the principal diagonal and using intercorrelations as the off-diagonal entries. Varying numbers of factors were extracted and rotated, both orthogonally to the Varimax criterion (Kaiser, 1958) and obliquely (Kaiser-Harris Type 2) to a solution (Harris & Kaiser, 1964).

Fletcher and Ree (1976) extracted four factors accounting for 69% of the variance in high school versions of ASVAB (Forms 2 and 5). These factors were rotated to a Varimax solution and interpreted as "technical information," "scholastic information" (verbal and quantitative tests), "attention to explicit rules" (speeded tests), and "spatial perception." Using the same ASVAB Form 5 data, Fischl et al. (1977) obtained five factors but employed an oblique solution. These unnamed factors were described as comprehension of verbal material, speed and accuracy, quantitative and abstract reasoning, spatial-mechanical, and automotive-shop information. The current study will attempt to confirm the similarity of the previous ASVAB structure and the structure of ASVAB Forms 8, 9, and 10.

III. RESULTS AND DISCUSSION

Item Analysis

Classical item analyses of the subtests are presented in Tables 2 through 13. The classical test and item statistics show the like-named tests among the six forms are generally equivalent in the AFQT-7a stratified samples in terms of means and standard deviations (SDs). Most of the items are above a difficulty of .50, making for a relatively easy set of subtests; this is generally confirmed by the indexes of skewness (Tables 2 through 7). The exception is the Mathematics Knowledge (MK) test which appears to be substantially more difficult than the others. Subtest reliabilities (KR-20), which are also in Tables 2 through 7, are all .80 or above.

Table 2. **Subtest Analysis of ASVAB Form 8a**

Subtest	Number of Items	Mean	SD	Skew	Kurtosis	Reliability
General Science (GS)	25	16.10	5.05	−.30	−.69	.84
Arithmetic Reasoning (AR)	30	17.82	7.13	.05	−1.08	.90
Word Knowledge (WK)	35	25.72	7.60	−.80	−.31	.92
Paragraph Comprehension (PC)	15	10.52	3.40	−.81	−.23	.80
Numerical Operations (NO)	50	35.35	10.28	−.45	−.38	*
Coding Speed (CS)	84	42.64	15.15	−.16	−.02	*
Auto−Shop Information (AS)	25	16.20	5.86	−.48	−.61	.88
Mathematics Knowledge (MK)	25	12.36	5.95	.41	−.75	.87
Mechanical Comprehension (MC)	25	15.50	5.61	−.32	−.82	.86
Electronics Information (EI)	20	12.28	4.42	−.41	−.72	.83

*Internal consistency reliability not computed for speeded subtests.

Table 3. **Subtest Analysis of ASVAB Form 8b**

Subtest	Number of Items	Mean	SD	Skew	Kurtosis	Reliability
General Science (GS)	25	13.92	5.12	−.31	−.61	.85
Arithmetic Reasoning (AR)	30	18.52	7.41	−.11	−1.10	.91
Word Knowledge (WK)	35	24.60	7.74	−.69	−.41	.92
Paragraph Comprehension (PC)	15	10.33	3.39	−.65	−.41	.80
Numerical Operations (NO)	50	35.77	10.14	−.63	−.01	*
Coding Speed (CS)	84	43.04	15.41	−.19	−.01	*
Auto−Shop Information (AS)	25	16.24	5.84	−.53	−.59	.88
Mathematics Knowledge (MK)	25	12.19	5.93	.49	−.75	.87
Mechanical Comprehension (MC)	25	15.24	5.68	−.27	−.91	.86
Electronics Information (EI)	20	12.20	4.45	−.38	−.75	.83

*Internal consistency reliability not computed for speeded subtests.

Table 4. **Subtest Analysis of ASVAB Form 9a**

Subtest	Number of Items	Mean	SD	Skew	Kurtosis	Reliability
General Science (GS)	25	15.52	5.73	−.29	−.88	.88
Arithmetic Reasoning (AR)	30	18.22	7.32	−.08	−1.09	.91
Word Knowledge (WK)	35	24.72	7.87	−.53	−.64	.92
Paragraph Comprehension (PC)	15	9.81	3.56	−.40	−.85	.81
Numerical Operations (NO)	50	35.04	10.70	−.62	−.18	*
Coding Speed (CS)	84	42.78	15.22	−.17	.13	*
Auto−Shop Information (AS)	25	16.71	5.85	−.66	−.26	.89
Mathematics Knowledge (MK)	25	12.42	5.88	.43	−.63	.87
Mechanical Comprehension (MC)	25	15.29	5.51	−.34	−.62	.85
Electronic Information (EI)	20	12.65	4.26	−.37	−.41	.82

*Internal consistency reliability not computed for speeded subtests.

Table 5. **Subtest Analysis of ASVAB Form 9b**

Subtest	Number of Items	Mean	SD	Skew	Kurtosis	Reliability
General Science (GS)	25	15.49	5.70	−.25	−.91	.87
Arithmetic Reasoning (AR)	30	18.43	7.21	−.03	−1.12	.91
Word Knowledge (WK)	35	24.83	7.89	−.67	−.52	.92
Paragraph Comprehension (PC)	15	10.41	3.33	−.74	−.18	.80
Numerical Operations (NO)	50	34.73	10.37	−.50	−.25	*
Coding Speed (CS)	84	43.04	14.66	−.14	.07	*
Auto−Shop Information (AS)	25	16.75	5.73	−.52	−.50	.81
Mathematics Knowledge (MK)	25	12.27	6.02	.51	−.65	.88
Mechanical Comprehension (MC)	25	15.26	5.29	−.23	−.72	.84
Electronics Information (EI)	20	12.72	4.07	−.35	−.35	.81

*Internal consistency reliability not computed for speeded subtests.

Table 6. **Subtest Analysis of ASVAB Form 10a**

Subtest	Number of Items	Mean	SD	Skew	Kurtosis	Reliability
General Science (GS)	25	15.49	5.33	−.34	−.63	.86
Arithmetic Reasoning (AR)	30	19.12	6.97	−.17	−1.10	.90
Word Knowledge (WK)	35	24.20	8.09	−.39	−.87	.93
Paragraph Comprehension (PC)	15	10.10	3.86	−.51	−.81	.84
Numerical Operations (NO)	50	35.80	10.12	−.57	−.24	*
Coding Speed (CS)	84	43.71	15.25	−.12	.01	*
Auto−Shop Information (AS)	25	16.59	5.67	−.57	−.44	.87
Mathematics Knowledge (MK)	25	13.35	5.65	.38	−.86	.86
Mechanical Comprehension (MC)	25	15.43	5.48	−.29	−.72	.86
Electronics Information (EI)	20	12.70	4.16	−.52	−.21	.81

*Internal consistency reliability not computed for speeded subtests.

Table 7. **Subtest Analysis of ASVAB Form 10b**

Subtest	Number of Items	Mean	SD	Skew	Kurtosis	Reliability
General Science (GS)	25	15.46	5.43	−.35	−.70	.86
Arithmetic Reasoning (AR)	30	18.24	7.26	−.08	−1.13	.91
Word Knowledge (WK)	35	24.41	7.90	−.53	−.73	.92
Paragraph Comprehension (PC)	15	10.61	3.24	−.69	−.32	.80
Numerical Operations (NO)	50	35.26	10.53	−.56	−.20	*
Coding Speed (CS)	84	43.33	14.76	−.05	.11	*
Auto−Shop Information (AS)	25	16.66	5.69	−.53	−.50	.88
Mathematics Knowledge (MK)	25	13.32	5.89	.30	−.89	.87
Mechanical Comprehension (MC)	25	15.13	5.47	−.23	−.81	.85
Electronics Information (EI)	20	12.35	4.11	−.43	−.28	.80

*Internal consistency reliability not computed for speeded subtests.

The item discrimination index values shown in Tables 8 through 13 are all quite high (only EI is below .30), with the majority between .60 and .99. These values are slightly overestimated for the shortest subtests, as no correction for overlap was applied. Because all but two subtests are long enough (25 or more items) to be not measurably affected, corrections were deemed unnecessary (Cureton, 1966).

Table 8. **Item Analytic Statistics for ASVAB Form 8a**

Subtest	Number of Items	Number of Items in Range					
		Difficulty (p)			Discrimination (r_{bis})		
		.25−.49	.50−.74	.75−.99	.10−.29	.30−.59	.60−.99
General Science (GS)	25	6	11	8	0	10	15
Arithmetic Reasoning (AR)	30	10	15	5	0	3	27
Word Knowledge (WK)	35	2	14	19	0	4	31
Paragraph Comprehension (PC)	15	1	8	6	0	2	13
Auto-Shop Information (AS)	25	3	17	5	0	4	21
Mathematics Knowledge (MK)	25	14	9	2	0	7	18
Mechanical Comprehension (MC)	25	4	16	5	0	9	16
Electronics Information (EI)	20	6	7	7	0	7	13

Table 9. **Item Analytic Statistics for ASVAB Form 8b**

Subtest	Number of Items	Number of Items in Range: Difficulty (p) .25–.49	.50–.74	.75–.99	Discrimination (r_{bis}) .10–.29	.30–.59	.60–.99
General Science (GS)	25	7	10	8	0	9	16
Arithmetic Reasoning (AR)	30	7	18	5	0	6	24
Word Knowledge (WK)	35	5	14	16	0	4	31
Paragraph Comprehension (PC)	15	2	7	6	0	2	13
Auto–Shop Information (AS)	25	3	16	6	0	9	16
Mathematical Knowledge (MK)	25	15	9	1	0	7	18
Mechanical Comprehension (MC)	25	6	16	3	0	8	17
Electronics Information (EI)	20	7	7	6	1	5	14

Table 10. **Item Analytic Statistics for ASVAB Form 9a**

Subtest	Number of Items	Number of Items in Range: Difficulty (p) .25–.49	.50–.74	.75–.99	Discrimination (r_{bis}) .10–.29	.30–.59	.60–.99
General Science (GS)	25	7	10	8	0	3	22
Arithmetic Reasoning (AR)	30	8	15	7	0	3	27
Word Knowledge (WK)	35	4	17	14	0	5	30
Paragraph Comprehension (PC)	15	3	7	5	0	2	13
Auto–Shop Information (AS)	25	4	14	7	0	4	21
Mathematics Knowledge (MK)	25	14	8	3	0	7	18
Mechanical Comprehension (MC)	25	5	15	5	0	11	14
Electronics Information (EI)	20	6	6	8	0	6	14

Table 11. **Item Analytic Statistics for ASVAB Form 9b**

Subtest	Number of Items	Number of Items in Range: Difficulty (p) .25–.49	.50–.74	.75–.99	Discrimination (r_{bis}) .10–.29	.30–.59	.60–.99
General Science (GS)	25	6	12	7	0	4	21
Arithmetic Reasoning (AR)	30	8	16	6	0	4	26
Word Knowledge (WK)	35	3	17	15	0	5	30
Paragraph Comprehension (PC)	15	2	6	7	0	3	12
Auto–Shop Information (AS)	25	4	14	7	0	4	21
Mathematics Knowledge (MK)	25	14	9	2	0	6	19
Mechanical Comprehension (MC)	25	4	17	4	0	8	17
Electronics Information (EI)	20	5	6	9	0	7	13

Table 12. **Item Analytic Statistics for ASVAB Form 10a**

Subtest	Number of Items	Number of Items in Range: Difficulty (p) .25–.49	.50–.74	.75–.99	Discrimination (r_{bis}) .10–.29	.30–.59	.60–.99
General Science (GS)	25	8	11	6	0	7	18
Arithmetic Reasoning (AR)	30	6	17	7	0	8	22
Word Knowledge (WK)	35	7	14	14	0	0	35
Paragraph Comprehension (PC)	15	0	11	4	0	1	14
Auto–Shop Information (AS)	25	2	17	6	0	3	22
Mathematics Knowledge (MK)	25	11	11	3	0	10	15
Mechanical Comprehension (MC)	25	6	12	7	0	10	15
Electronics Information (EI)	20	6	6	8	1	5	14

Table 13. **Item Analytic Statistics for ASVAB Form 10b**

Subtest	Number of Items	Number of Items in Range: Difficulty (p) .25–.49	.50–.74	.75–.99	Discrimination (r_{bis}) .10–.29	.30–.59	.60–.99
General Science (GS)	25	7	12	6	0	6	19
Arithmetic Reasoning (AR)	30	10	15	5	0	5	25
Word Knowledge (WK)	35	5	17	13	0	8	27
Paragraph Comprehension (PC)	15	3	3	9	0	2	13
Auto–Shop Information (AS)	25	2	17	6	0	4	21
Mathematics Knowledge (MK)	25	13	10	2	0	7	18
Mechanical Comprehension (MC)	25	7	13	5	0	10	15
Electronics Information (EI)	20	7	6	7	0	7	13

Item Response Theory Item Analyses

Each subtest was analyzed separately to estimate the Item Response Theory (IRT) item parameters. Tables 14, 15, and 16 display the means of the three important IRT parameters of the items comprising the various subtests, by form.

Table 14. **Means of IRT Item Parameters[a] for ASVAB Form 8**

Subtest	Form 8a			Form 8b		
	$\bar{a}$	$\bar{b}$	$\bar{c}$	$\bar{a}$	$\bar{b}$	$\bar{c}$
General Science (GS)	1.49	−.09	.23	1.51	−.02	.24
Arithmetic Reasoning (AR)	1.47	.12	.16	1.68	−.08	.15
Word Knowledge (WK)	1.48	−.63	.22	1.63	−.47	.16
Paragraph Comprehension (PC)	1.48	−.34	.24	1.80	−.33	.26
Auto-Shop Information (AS)	1.46	−.22	.19	1.37	−.17	.18
Mathematics Knowledge (MK)	1.58	.48	.22	1.58	.48	.21
Mechanical Comprehension (MC)	1.37	.02	.24	1.38	.08	.24
Electronics Information (EI)	1.54	.10	.23	1.55	.15	.25

[a]Refers to item parameters of logistic models where a is the item discrimination parameter, b is the item difficulty parameter, and c is the item guessing parameter.

Table 15. **Means of IRT Item Parameters[a] for ASVAB Form 9**

Subtest	Form 9a			Form 9b		
	$\bar{a}$	$\bar{b}$	$\bar{c}$	$\bar{a}$	$\bar{b}$	$\bar{c}$
General Science (GS)	1.51	−.06	.20	1.46	−.03	.21
Arithmetic Reasoning (AR)	1.55	.00	.19	1.62	−.02	.19
Word Knowledge (WK)	1.69	−.41	.15	1.51	−.39	.15
Paragraph Comprehension (PC)	1.73	−.18	.23	1.05	−.44	.21
Auto-Shop Information (AS)	1.57	−.35	.18	1.59	−.35	.18
Mathematics Knowledge (MK)	1.67	.38	.22	1.65	.38	.19
Mechanical Comprehension (MC)	1.39	.07	.25	1.37	.09	.28
Electronics Information (EI)	1.66	−.05	.26	1.67	−.06	.27

[a]Refers to item parameters of logistic models where a is the item discrimination parameter, b is the item difficulty parameter, and c is the item guessing parameter.

Table 16. **Means of IRT Item Parameters[a] for ASVAB Form 10**

Subtest	Form 10a			Form 10b		
	$\bar{a}$	$\bar{b}$	$\bar{c}$	$\bar{a}$	$\bar{b}$	$\bar{c}$
General Science (GS)	1.53	−.04	.20	1.54	−.05	.18
Arithmetic Reasoning (AR)	1.60	−.01	.20	1.68	−.03	.15
Word Knowledge (WK)	1.80	−.42	.15	1.59	−.43	.16
Paragraph Comprehension (PC)	1.65	−.29	.16	1.60	−.26	.39
Auto-Shop Information (AS)	1.46	−.24	.22	1.47	−.26	.21
Mathematics Knowledge (MK)	1.61	.27	.20	1.64	.26	.20
Mechanical Comprehension (MC)	1.39	.01	.25	1.36	.08	.26
Electronics Information (EI)	1.62	−.24	.22	1.56	−.07	.24

[a]Refers to item parameters of logistic models where a is the item discrimination parameter, b is the item difficulty parameter, and c is the item guessing parameter.

Figures 1 through 8 show the test information curves for ASVAB Form 8a subtests. This form was selected to represent all six forms since the IRT analyses of its items are generally representative. The horizontal axis represents theta, the ability estimate. The vertical axis represents test information. Test information is an IRT analogue to classical reliability, except that it is superior as it offers a value at any score point. It may be thought of as a rough conditional reliability. Note that all subtests with the exception of Arithmetic Reasoning and Mathematics Knowledge have information curve peaks at or below the mean as would be expected in relatively easy subtests.

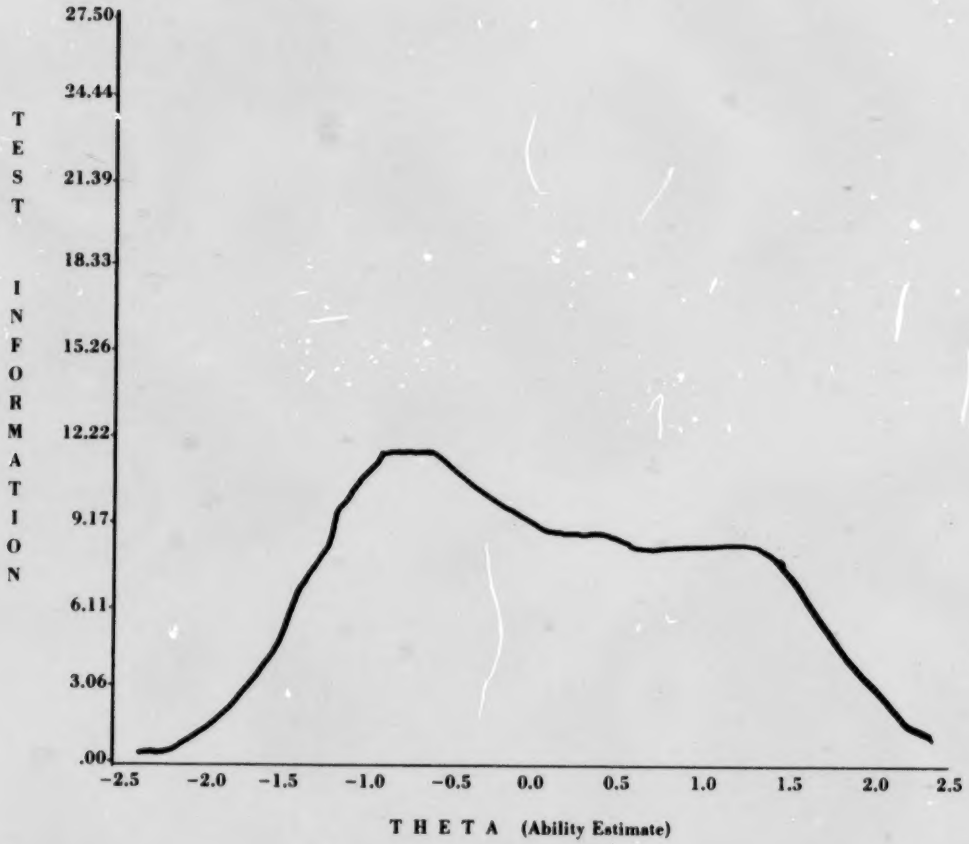

Figure 1. **Test information curve for General Science.**

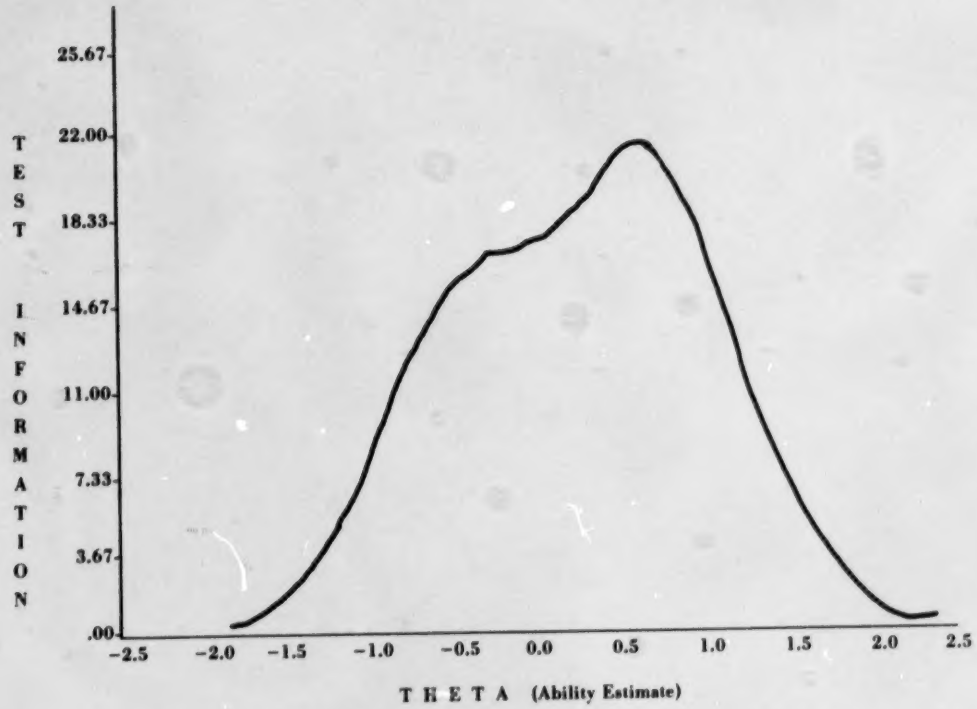

Figure 2. **Test information curve for Arithmetic Reasoning.**

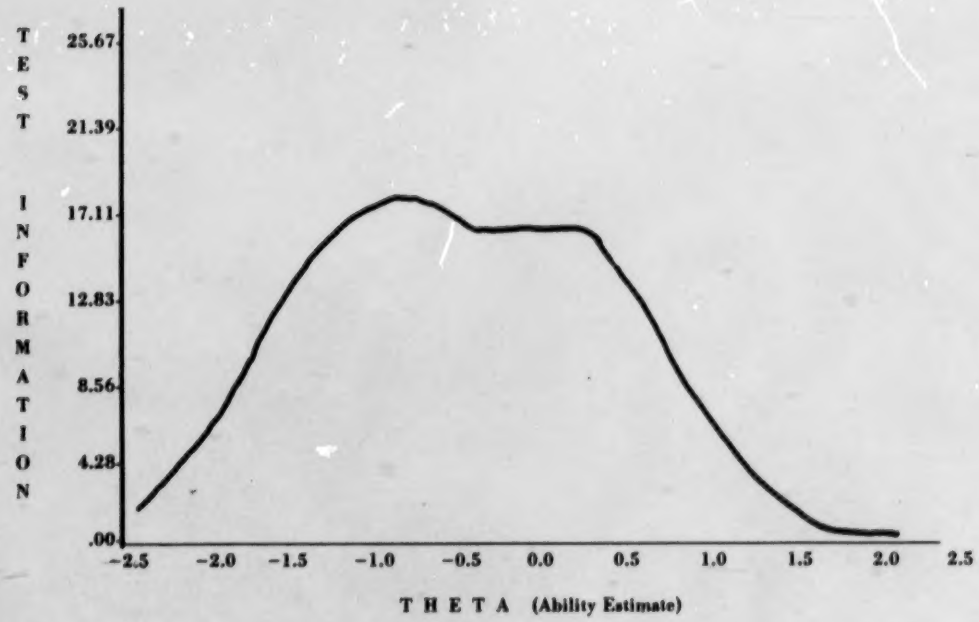

Figure 3. **Test information curve for Word Knowledge.**

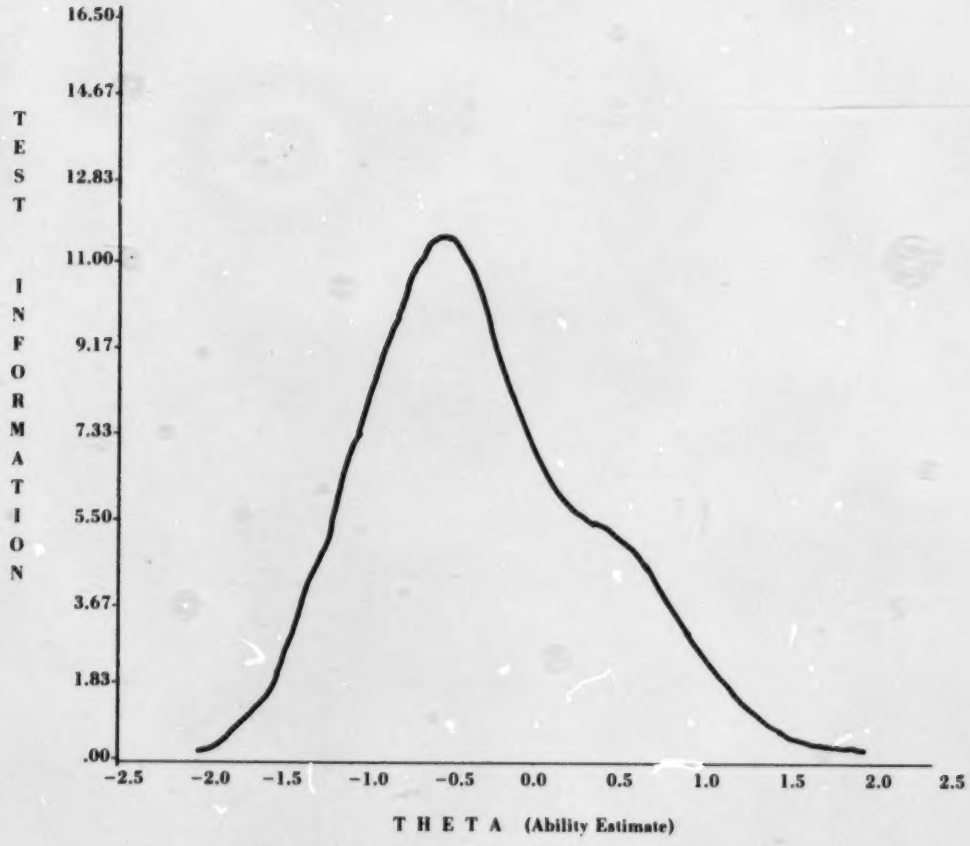

Figure 4. **Test information curve for Paragraph Comprehension.**

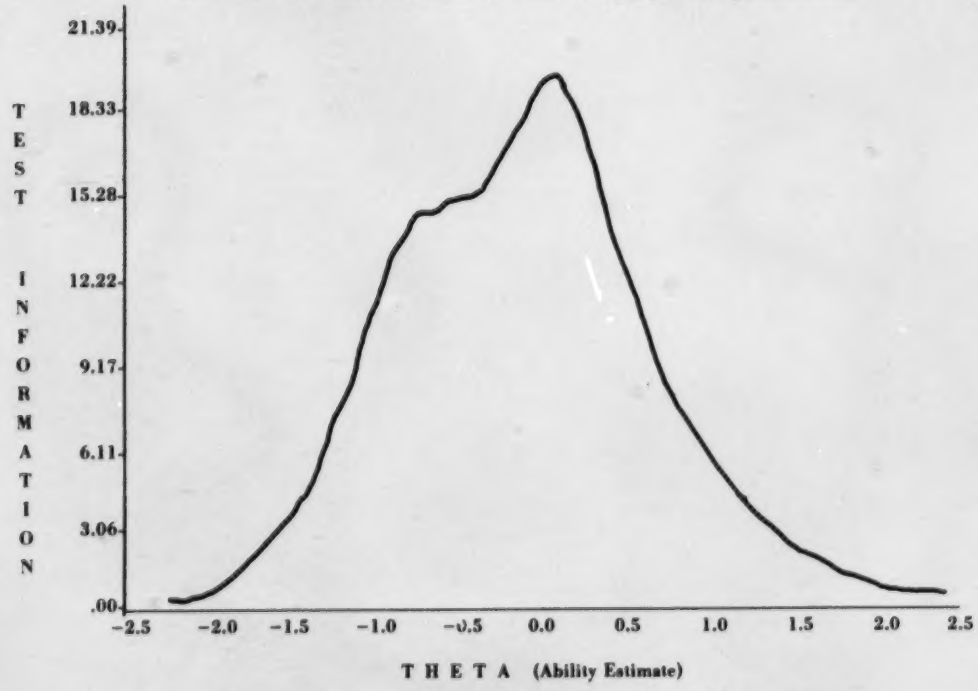

Figure 5. **Test information curve for Auto-Shop Information.**

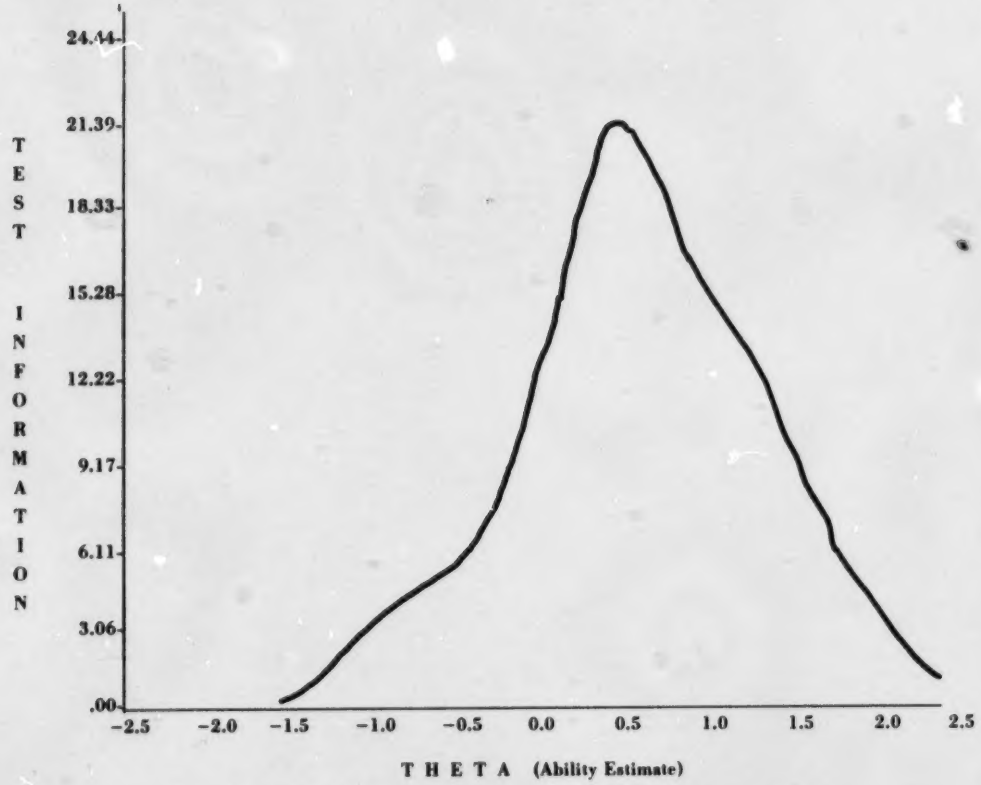

Figure 6. **Test information curve for Mathematics Knowledge.**

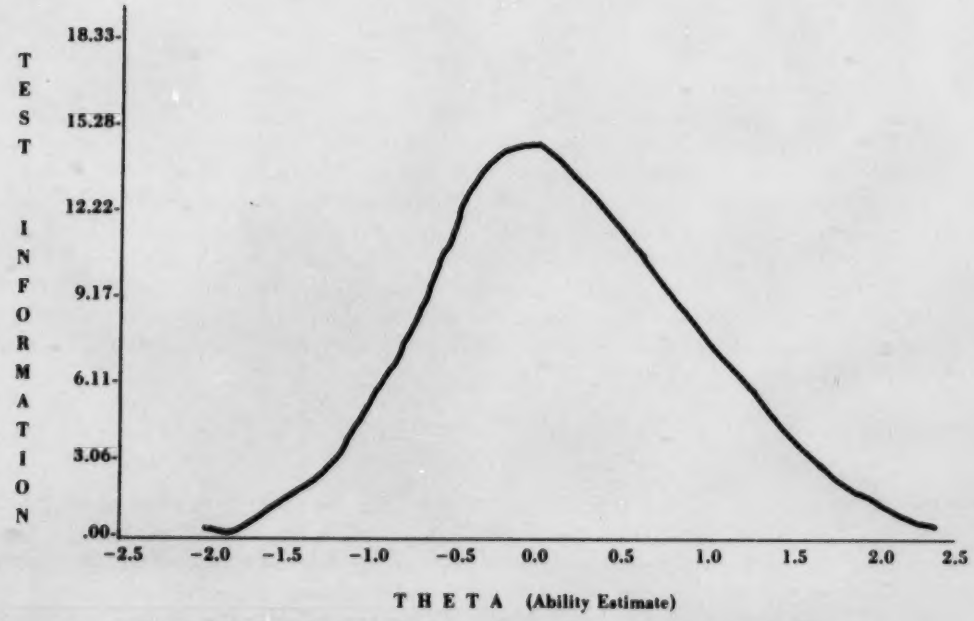

Figure 7. **Test information curve for Mechanical Comprehension.**

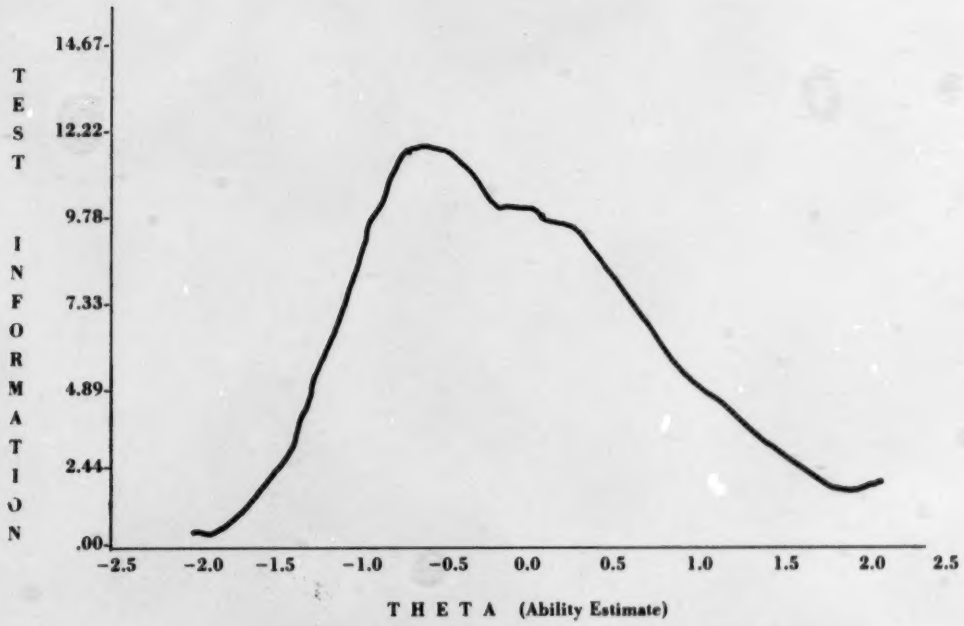

Figure 8. **Test information curve for Electronics Information.**

The General Science test information curve has a broad and rather irregular shape. This is due to the distribution of item *b* values (difficulty) and possibly to the violation of the unidimensionality assumption for this heterogeneous subtest. The peaks observed in the other subtests appear to reflect the distribution of item *b* parameters. The information curve for Paragraph Comprehension shows the greatest information per item which may be spurious, as the *a* parameters (item discrimination) in this short subtest (15 items) are probably overestimated. This overestimation cannot be avoided in short subtests, so caution must be exercised in interpreting all these curves, but especially Paragraph Comprehension. It should be noted that the heterogeneous appearing 25-item Auto-Shop subtest information curve shows about as much information per item as the homogeneous appearing subtests. Heterogeneity of these item types should have produced far less average information per item. This verifies the efficacy of using the two types of items as a single score. Finally, the relatively low information per item found for the Electronics Information and Mechanical Comprehension subtests is interpreted as an indicator of test heterogeneity. It may be observed that information in most of these subtests is better distributed for use with lower ability examinees than with higher ability examinees. The effects of this situation remain to be investigated in validity studies.

Factor Analysis

Three types of factor analysis were conducted on the data. The intercorrelation matrices are provided in Tables 17 through 22. Inspection shows them to be generally similar. The first analysis was to factor the subtest scores for each of the six forms. The second was to factor the subtests of the six forms and the total score on the AFQT-7a. The third was to factor the subtests of the six forms and the subtests of the AFQT-7a. In each analysis, varying numbers of factors were extracted and rotated both orthogonally and obliquely. Tables 23 through 28 show

Table 17. **Intercorrelation Matrix of ASVAB–8a Subtests and AFQT-7a Subtests and Total**

Subtest	ASVAB-8a										AFQT-7a				
	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	WK-7a	AR-7a	TK-7a	SP-7a	QT-7a
General Science (GS)	1.00														
Arithmetic Reasoning (AR)	.71	1.00													
Word Knowledge (WK)	.83	.70	1.00												
Paragraph Comprehension (PC)	.74	.70	.82	1.00											
Numerical Operations (NO)	.48	.59	.52	.55	1.00										
Coding Speed (CS)	.43	.52	.48	.49	.64	1.00									
Auto–Shop Information (AS)	.70	.60	.68	.63	.40	.42	1.00								
Mathematics Knowledge (MK)	.65	.79	.62	.60	.58	.51	.52	1.00							
Mechanical Comprehension (MC)	.71	.69	.67	.64	.45	.45	.75	.64	1.00						
Electronics Information (EI)	.78	.68	.76	.69	.46	.46	.79	.61	.75	1.00					
Word Knowledge (WK-7a)	.81	.69	.89	.79	.50	.47	.66	.61	.66	.74	1.00				
Arithmetic Reasoning (AR-7a)	.72	.87	.73	.73	.61	.53	.64	.73	.71	.69	.73	1.00			
Tool Knowledge (TK-7a)	.57	.48	.51	.49	.33	.29	.71	.36	.64	.63	.53	.53	1.00		
Space Perception (SP-7a)	.57	.61	.53	.53	.41	.39	.54	.53	.65	.55	.54	.63	.54	1.00	
AFQT-7a Raw Total[a]	.80	.81	.81	.77	.56	.51	.76	.69	.80	.79	.85	.88	.76	.82	1.00

[a]Not corrected for spurious overlap.

Table 18. **Intercorrelation Matrix of ASVAB-8b Subtests and AFQT-7a Subtests and Total**

Subtest	ASVAB-8b										AFQT-7a				
	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	WK-7a	AR-7a	TK-7a	SP-7a	QT-7a
General Science (GS)	1.00														
Arithmetic Reasoning (AR)	.71	1.00													
Word Knowledge (WK)	.83	.73	1.00												
Paragraph Comprehension (PC)	.75	.71	.81	1.00											
Numerical Operations (NO)	.51	.64	.56	.55	1.00										
Coding Speed (CS)	.42	.51	.47	.48	.65	1.00									
Auto–Shop Information (AS)	.68	.61	.65	.62	.43	.42	1.00								
Mathematics Knowledge (MK)	.63	.78	.62	.62	.57	.50	.53	1.00							
Mechanical Comprehension (MC)	.71	.69	.67	.66	.47	.45	.78	.63	1.00						
Electronics Information (EI)	.76	.66	.74	.69	.45	.43	.78	.61	.75	1.00					
Word Knowledge (WK-7a)	.81	.71	.90	.80	.54	.45	.66	.59	.66	.74	1.00				
Arithmetic Reasoning (AR-7a)	.73	.88	.76	.73	.64	.51	.65	.72	.70	.69	.76	1.00			
Tool Knowledge (TK-7a)	.55	.46	.50	.48	.31	.26	.69	.36	.62	.59	.52	.54	1.00		
Space Perception (SP-7a)	.56	.59	.54	.53	.39	.38	.52	.53	.65	.55	.55	.62	.55	1.00	
AFQT-7a Raw Total[a]	.80	.80	.81	.77	.57	.49	.75	.67	.79	.77	.85	.89	.76	.82	1.00

[a]Not corrected for spurious overlap.

Table 19. **Intercorrelation Matrix of ASVAB-9a Subtests and AFQT-7a Subtests and Total**

Subtest	ASVAB-9a										AFQT-7a				
	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	WK-7a	AR-7a	TK-7a	SP-7a	QT-7a
General Science (GS)	1.00														
Arithmetic Reasoning (AR)	.73	1.00													
Word Knowledge (WK)	.86	.74	1.00												
Paragraph Comprehension (PC)	.78	.74	.82	1.00											
Numerical Operations (NO)	.47	.61	.51	.53	1.00										
Coding Speed (CS)	.45	.56	.49	.50	.67	1.00									
Auto–Shop Information (AS)	.73	.64	.71	.66	.41	.45	1.00								
Mathematics Knowledge (MK)	.67	.81	.66	.65	.55	.52	.57	1.00							
Mechanical Comprehension (MC)	.73	.72	.71	.69	.44	.48	.77	.69	1.00						
Electronics Information (EI)	.74	.65	.73	.67	.41	.45	.80	.62	.76	1.00					
Word Knowledge (WK-7a)	.82	.70	.89	.78	.51	.48	.69	.61	.67	.69	1.00				
Arithmetic Reasoning (AR-7a)	.73	.87	.75	.74	.63	.56	.67	.74	.72	.66	.75	1.00			
Tool Knowledge (TK-7a)	.58	.50	.54	.53	.30	.32	.72	.40	.62	.61	.54	.55	1.00		
Space Perception (SP-7a)	.58	.63	.57	.55	.41	.41	.55	.58	.65	.54	.57	.65	.56	1.00	
AFQT-7a Raw Total[a]	.81	.81	.83	.78	.56	.54	.78	.71	.80	.74	.86	.89	.77	.83	1.00

[a]Not corrected for spurious overlap.

Table 20. **Intercorrelation Matrix of ASVAB-9b Subtests and AFQT-7a Subtests and Total**

Subtest	ASVAB-9b										AFQT-7a				
	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	WK-7a	AR-7a	TK-7a	SP-7a	QT-7a
General Science (GS)	1.00														
Arithmetic Reasoning (AR)	.71	1.00													
Word Knowledge (WK)	.85	.74	1.00												
Paragraph Comprehension (PC)	.76	.70	.82	1.00											
Numerical Operations (NO)	.52	.64	.57	.56	1.00										
Coding Speed (CS)	.45	.54	.50	.49	.66	1.00									
Auto–Shop Information (AS)	.72	.63	.69	.65	.41	.43	1.00								
Mathematics Knowledge (MK)	.67	.81	.66	.61	.59	.51	.54	1.00							
Mechanical Comprehension (MC)	.71	.71	.68	.64	.46	.45	.76	.67	1.00						
Electronics Information (EI)	.75	.64	.72	.66	.46	.44	.81	.59	.75	1.00					
Word Knowledge (WK-7a)	.81	.69	.89	.77	.54	.47	.66	.61	.65	.69	1.00				
Arithmetic Reasoning (AR-7a)	.72	.88	.75	.71	.65	.52	.65	.74	.70	.65	.74	1.00			
Tool Knowledge (TK-7a)	.54	.49	.50	.45	.31	.31	.71	.39	.62	.62	.49	.52	1.00		
Space Perception (SP-7a)	.57	.61	.56	.52	.43	.42	.56	.57	.68	.56	.56	.64	.56	1.00	
AFQT-7a Raw Total[a]	.80	.82	.82	.75	.59	.52	.77	.71	.80	.76	.84	.88	.75	.84	1.00

[a]Not corrected for spurious overlap.

Table 21. **Intercorrelation Matrix of ASVAB-10a Subtests and AFQT-7a Subtests and Total**

Subtest	ASVAB-10a										AFQT-7a				
	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	WK-7a	AR-7a	TK-7a	SP-7a	QT-7a
General Science (GS)	1.00														
Arithmetic Reasoning (AR)	.74	1.00													
Word Knowledge (WK)	.83	.75	1.00												
Paragraph Comprehension (PC)	.76	.72	.83	1.00											
Numerical Operations (NO)	.49	.60	.51	.52	1.00										
Coding Speed (CS)	.46	.54	.50	.52	.68	1.00									
Auto–Shop Information (AS)	.66	.61	.65	.61	.37	.42	1.00								
Mathematics Knowledge (MK)	.70	.78	.68	.65	.57	.52	.51	1.00							
Mechanical Comprehension (MC)	.75	.73	.71	.67	.45	.46	.74	.69	1.00						
Electronics Information (EI)	.74	.67	.73	.67	.43	.48	.77	.63	.77	1.00					
Word Knowledge (WK-7a)	.81	.73	.88	.79	.50	.48	.67	.63	.70	.73	1.00				
Arithmetic Reasoning (AR-7a)	.75	.87	.76	.72	.62	.55	.63	.73	.73	.68	.76	1.00			
Tool Knowledge (TK-7a)	.57	.51	.50	.47	.28	.30	.70	.39	.61	.62	.54	.55	1.00		
Space Perception (SP-7a)	.60	.61	.55	.52	.39	.40	.50	.55	.65	.54	.56	.63	.56	1.00	
AFQT-7a Raw Total[a]	.82	.82	.81	.75	.54	.52	.74	.69	.81	.77	.86	.89	.77	.82	1.00

[a]Not corrected for spurious overlap.

Table 22. **Intercorrelation Matrix of ASVAB-10b Subtests and AFQT-7a Subtests and Total**

Subtest	ASVAB-10b										AFQT-7a				
	GS	AR	WK	PC	NO	CS	AS	MK	MC	EI	WK-7a	AR-7a	TK-7a	SP-7a	QT-7a
General Science (GS)	1.00														
Arithmetic Reasoning (AR)	.73	1.00													
Word Knowledge (WK)	.83	.73	1.00												
Paragraph Comprehension (PC)	.76	.73	.81	1.00											
Numerical Operations (NO)	.52	.65	.54	.57	1.00										
Coding Speed (CS)	.47	.50	.50	.53	.69	1.00									
Auto-Shop Information (AS)	.68	.66	.66	.62	.41	.42	1.00								
Mathematics Knowledge (MK)	.71	.68	.68	.68	.60	.55	.55	1.00							
Mechanical Comprehension (MC)	.75	.71	.71	.68	.48	.48	.73	.72	1.00						
Electronics Information (EI)	.75	.72	.72	.67	.47	.47	.75	.66	.75	1.00					
Word Knowledge (WK-7a)	.82	.71	.89	.78	.55	.48	.67	.65	.70	.72	1.00				
Arithmetic Reasoning (AR-7a)	.75	.87	.76	.75	.65	.55	.64	.77	.74	.67	.76	1.00			
Tool Knowledge (TK-7a)	.55	.47	.49	.46	.30	.29	.67	.40	.61	.57	.51	.52	1.00		
Space Perception (SP-7a)	.59	.62	.55	.54	.41	.40	.54	.58	.68	.56	.56	.63	.56	1.00	
AFQT-7a Raw Total[a]	.82	.81	.81	.77	.58	.53	.75	.73	.82	.76	.86	.89	.75	.83	1.00

[a]Not corrected for spurious overlap.

Table 23. **Factor Analysis of ASVAB Subtests for Form 8a**
(Oblique Solution)

Subtest	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.54	.27	.26	−.04	3			
Arithmetic Reasoning (AR)	.21	.15	.59	.14			2	
Word Knowledge (WK)	.70	.16	.13	.08	1			
Paragraph Comprehension (PC)	.62	.12	.15	.17	2			
Numerical Operations (NO)	.13	.08	.19	.57				1
Coding Speed (CS)	.07	.20	.10	.56				2
Auto-Shop Information (AS)	.23	.68	.04	.01		1		
Mathematics Knowledge (MK)	.10	.12	.62	.17			1	
Mechanical Comprehension (MC)	.13	.58	.29	.00		2		
Electronics Information (EI)	.33	.56	.14	.02	4	3		

Correlation Matrix of Factors

I	1.00			
II	.60	1.00		
III	.54	.51	1.00	
IV	.31	.25	.45	1.00

Note. — Only factor loadings ≥ .30 are ranked.

Table 24. **Factor Analysis of ASVAB Subtests for Form 8b**
(Oblique Solution)

Subtest	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.28	.56	.20	.04		2		
Arithmetic Reasoning (AR)	.15	.22	.56	.17			2	
Word Knowledge (WK)	.17	.66	.12	.17		1		
Paragraph Comprehension (PC)	.18	.54	.15	.21		3		
Numerical Operations (NO)	.10	.07	.20	.59				1
Coding Speed (CS)	.22	−.02	.10	.58				2
Auto-Shop Information (AS)	.73	.15	.05	.03	1			
Mathematics Knowledge (MK)	.15	.10	.60	.15			1	
Mechanical Comprehension (MC)	.62	.12	.25	.01	2			
Electronics Information (EI)	.59	.31	.12	.00	3	4		

Correlation Matrix of Factors

I	1.00			
II	.57	1.00		
III	.51	.52	1.00	
IV	.31	.33	.50	1.00

Note. — Only factor loadings ≥ .30 are ranked.

Table 25. **Factor Analysis of ASVAB Subtests for Form 9a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.29	.56	.18	.06		2		
Arithmetic Reasoning (AR)	.13	.21	.56	.22			2	
Word Knowledge (WK)	.23	.62	.12	.16		1		
Paragraph Comprehension (PC)	.19	.51	.18	.21		3		
Numerical Operations (NO)	.08	.04	.16	.64				1
Coding Speed (CS)	.22	−.03	.11	.61				2
Auto-Shop Information (AS)	.72	.16	.07	.04	1			
Mathematics Knowledge (MK)	.13	.12	.62	.16			1	
Mechanical Comprehension (MC)	.55	.11	.35	.00	3		3	
Electronics Information (EI)	.66	.19	.15	.01	2			

Correlation Matrix of Factors

I	1.00			
II	.58	1.00		
III	.53	.52	1.00	
IV	.31	.32	.49	1.00

Note. — Only factor loadings ≥ .30 are ranked.

Table 26. **Factor Analysis of ASVAB Subtests for Form 9b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.63	.21	.22	−.03	3			
Arithmetic Reasoning (AR)	.22	.18	.57	.16			2	
Word Knowledge (WK)	.73	.09	.18	. 06	1			
Paragraph Comprehension (PC)	.66	.10	.14	.12	2			
Numerical Operations (NO)	.20	.08	.19	.56				1
Coding Speed (CS)	.14	.21	.07	.55				2
Auto-Shop Information (AS)	.31	.65	.03	−.03	5	1		
Mathematics Knowledge (MK)	.11	.17	.62	.14			1	
Mechanical Comprehension (MC)	.18	.54	.30	−.02		3	3	
Electronics Information (EI)	.34	.60	.07	.03	4	2		

Correlation Matrix of Factors

I	1.00			
II	.59	1.00		
III	.54	.49	1.00	
IV	.30	.20	.42	1.00

Note. — Only factor loadings ≥ .30 are ranked.

Table 27. **Factor Analysis of ASVAB Subtests for Form 10a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.30	.47	.27	−.05		3		
Arithmetic Reasoning (AR)	.18	.21	.50	.23			2	
Word Knowledge (WK)	.24	.60	.14	.14		1		
Paragraph Comprehension (PC)	.22	.54	.10	.22		2		
Numerical Operations (NO)	.11	.03	.15	.65				1
Coding Speed (CS)	.25	−.01	.04	.63				2
Auto-Shop Information (AS)	.75	.12	.06	−.01	1			
Mathematics Knowledge (MK)	.10	.15	.57	.22			1	
Mechanical Comprehension (MC)	.55	.08	.38	−.01	3		3	
Electronics Information (EI)	.67	.17	.14	.04	2			

Correlation Matrix of Factors

I	1.00			
II	.56	1.00		
III	.56	.57	1.00	
IV	.32	.33	.45	1.00

Note. — Only factor loadings ≥ .30 are ranked.

Table 28. **Factor Analysis of ASVAB Subtests for Form 10b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.29	.23	.50	−.05			3	
Arithmetic Reasoning (AR)	.13	.56	.19	.02		2		
Word Knowledge (WK)	.23	.12	.60	.15			1	
Paragraph Comprehension (PC)	.19	.16	.51	.23			2	
Numerical Operations (NO)	.11	.18	.05	.63				1
Coding Speed (CS)	.21	.12	−.02	.60				2
Auto-Shop Information (AS)	.69	.08	.14	.00	1			
Mathematics Knowledge (MK)	.12	.63	.13	.16		1		
Mechanical Comprehension (MC)	.51	.37	.14	−.01	3	3		
Electronics Information (EI)	.61	.17	.20	.03	2			

Correlation Matrix of Factors

I	1.00			
II	.56	1.00		
III	.60	.55	1.00	
IV	.32	.49	.34	1.00

Note. — Only factor loadings ≥ .30 are ranked.

the most interpretable solutions (oblique) for the analyses of the sets of subtests. Following convention, loadings of .30 or more were deemed significant. The percentages of variance accounted for were 73.3, 73.1, 74.1, 74.0, 73.6, and 74.3 for Forms 8a, 8b, 9a, 9b, 10a, and 10b, respectively. The four factors obtained show a median intercorrelation of .51 with a limited range.

The clearest regularity in the analyses is the consistent appearance of a Clerical/Speed factor involving the NO and CS subtests. Similarly, a factor with PC, WK, and GS representing a Verbal Abilities factor appears in each analysis as does a Mathematical factor always involving AR and MK. In Forms 8a and 8b, this factor appears without MC. In the other forms, MC is lightly loaded on this factor. Finally, there is a reasonably consistent factor measuring Vocational-Technical Information comprised of AS, MC, and EI.

When similar analyses were conducted including the score on AFQT-7a, similar and consistent results were observed (see Tables 29 through 34). The score on AFQT-7a loaded significantly (≥.30) on three of the four factors. It did not load on the Clerical/Speed factor. This is not surprising as AFQT-7a does not have any comparable Clerical/Speed test items.

Table 29. **Factor Analysis of ASVAB Subtests and AFQT-7a for Form 8a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.55	.25	.26	−.04	3			
Arithmetic Reasoning (AR)	.20	.13	.63	.13			1	
Word Knowledge (WK)	.72	.13	.13	.08	1			
Paragraph Comprehension (PC)	.62	.10	.15	.17	2			
Numerical Operations (NO)	.14	.08	.19	.57				1
Coding Speed (CS)	.08	.20	.09	.56				2
Auto-Shop Information (AS)	.24	.68	.03	.00		1		
Mathematics Knowledge (MK)	.10	.12	.61	.18			2	
Mechanical Comprehension (MC)	.12	.59	.29	.00		2		
Electronics Information (EI)	.35	.54	.13	.02	5	3		
AFQT-7a Total Score (QT-7a)	.35	.39	.33	.06	4	4	3	

Correlation Matrix of Factors

I	1.00			
II	.61	1.00		
III	.56	.53	1.00	
IV	.31	.25	.44	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 30. **Factor Analysis of ASVAB Subtests and AFQT-7a for Form 8b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.27	.56	.19	.05		2		
Arithmetic Reasoning (AR)	.13	.20	.60	.17			1	
Word Knowledge (WK)	.16	.66	.12	.18		1		
Paragraph Comprehension (PC)	.18	.54	.15	.21		3		
Numerical Operations (NO)	.10	.06	.21	.59				1
Coding Speed (CS)	.23	−.03	.09	.58				2
Auto-Shop Information (AS)	.74	.14	.05	.03	1			
Mathematics Knowledge (MK)	.15	.08	.59	.16			2	
Mechanical Comprehension (MC)	.64	.11	.26	.01	2			
Electronics Information (EI)	.59	.31	.11	.02	3	5		
AFQT-7a Total Score (QT-7a)	.39	.36	.32	.06	4	4	3	

Correlation Matrix of Factors

I	1.00			
II	.58	1.00		
III	.53	.53	1.00	
IV	.32	.33	.50	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 31. **Factor Analysis of ASVAB Subtests and AFQT-7a for Form 9a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.29	.56	.18	.06		2		
Arithmetic Reasoning (AR)	.11	.20	.59	.21			2	
Word Knowledge (WK)	.23	.63	.11	.16		1		
Paragraph Comprehension (PC)	.19	.51	.18	.21		3		
Numerical Operations (NO)	.08	.03	.16	.65				1
Coding Speed (CS)	.23	−.04	.10	.61				2
Auto-Shop Information (AS)	.74	.16	.07	.03	1			
Mathematics Knowledge (MK)	.12	.11	.62	.16			1	
Mechanical Comprehension (MC)	.56	.10	.36	.00	3		3	
Electronics Information (EI)	.65	.18	.14	.01	2			
AFQT-7a Total Score (QT-7a)	.38	.33	.30	.14	4	4	4	

Correlation Matrix of Factors

I	1.00			
II	.59	1.00		
III	.55	.54	1.00	
IV	.33	.33	.49	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 32. **Factor Analysis of ASVAB Subtests for AFQT-7a for Form 9b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.64	.19	.22	−.03	3			
Arithmetic Reasoning (AR)	.20	.17	.59	.16			2	
Word Knowledge (WK)	.75	.06	.18	.06	1			
Paragraph Comprehension (PC)	.67	.08	.15	.12	2			
Numerical Operations (NO)	.20	.08	.18	.56				1
Coding Speed (CS)	.15	.21	.05	.55				2
Auto-Shop Information (AS)	.32	.65	.02	−.03	6	1		
Mathematics Knowledge (MK)	.11	.16	.61	.16			1	
Mechanical Comprehension (MC)	.17	.55	.30	−.03		3	4	
Electronics Information (EI)	.37	.59	.05	.03	5	2		
AFQT-7a Total Score (QT-7a)	.38	.36	.33	.05	4	4	3	

Correlation Matrix of Factors

I	1.00			
II	.60	1.00		
III	.56	.51	1.00	
IV	.30	.20	.41	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 33. **Factor Analysis of ASVAB Subtests and AFQT-7a for Form 10a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.29	.47	.26	.06		3		
Arithmetic Reasoning (AR)	.16	.19	.54	.22			2	
Word Knowledge (WK)	.23	.60	.13	.15		1		
Paragraph Comprehension (PC)	.21	.54	.10	.23		2		
Numerical Operations (NO)	.11	.03	.14	.65				1
Coding Speed (CS)	.25	−.01	.03	.63				2
Auto-Shop Information (AS)	.76	.10	.06	−.01	1			
Mathematics Knowledge (MK)	.09	.15	.55	.24			1	
Mechanical Comprehension (MC)	.54	.08	.39	−.01	3		3	
Electronics Information (EI)	.67	.16	.13	.04	2			
AFQT-7a Total Score (QT-7a)	.43	.27	.33	.09	4		4	

Correlation Matrix of Factors

I	1.00			
II	.58	1.00		
III	.57	.58	1.00	
IV	.32	.34	.45	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 34. **Factor Analysis of ASVAB Subtests and AFQT-7a for Form 10b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.27	.23	.51	.05			3	
Arithmetic Reasoning (AR)	.11	.59	.19	.22		2		
Word Knowledge (WK)	.21	.11	.62	.14			1	
Paragraph Comprehension (PC)	.18	.16	.51	.23			2	
Numerical Operations (NO)	.12	.18	.05	.63				1
Coding Speed (CS)	.22	.11	−.01	.60				2
Auto-Shop Information (AS)	.70	.08	.14	.00	1			
Mathematics Knowledge (MK)	.09	.63	.14	.17		1		
Mechanical Comprehension (MC)	.51	.39	.12	−.03	3	3		
Electronics Information (EI)	.60	.16	.20	.03	2			
AFQT-7a Total Score (QT-7a)	.40	.33	.31	.07	4	4	4	

Correlation Matrix of Factors

I	1.00			
II	.58	1.00		
III	.62	.58	1.00	
IV	.31	.48	.34	1.00

Note. — Only factor loadings ≥.30 are ranked.

The AFQT-7a contains four sets of 25 items measuring Word Knowledge, Arithmetic Reasoning, Tool Knowledge, and Space Perception. Factor analyses using ASVAB subtests and each set of 25 homogeneous items in AFQT-7a were conducted (see Tables 35 through 40). As would be expected, these subtests loaded on the four factors in a logical manner: Word Knowledge loaded on the verbal factor, Arithmetic Reasoning on the mathematics factor, and Tool Knowledge on the vocational-technical factor.

Table 35. **Factor Analysis of ASVAB and AFQT-7a Subtests for Form 8a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.57	.27	.24	−.02	4			
Arithmetic Reasoning (AR)	.17	.18	.67	.11			1	
Word Knowledge (WK)	.78	.10	.13	.09	1			
Paragraph Comprehension (PC)	.59	.13	.19	.17	3			
Numerical Operations (NO)	.10	.14	.18	.58				1
Coding Speed (CS)	.09	.20	.08	.57				2
Auto-Shop Information (AS)	.29	.70	−.02	.01		2		
Mathematics Knowledge (MK)	.14	.12	.59	.19			2	
Mechanical Comprehension (MC)	.17	.60	.28	−.01		3		
Electronics Information (EI)	.41	.51	.10	.04	5	4		
Word Knowledge (WK-7a)	.74	.12	.15	.07	2			
Arithmetic Reasoning (AR-7a)	.22	.25	.54	.14			3	
Tool Knowledge (TK-7a)	.13	.73	−.02	−.05		1		
Space Perception (SP-7a)	.05	.45	.34	.03		5	4	

Correlation Matrix of Factors

I	1.00			
II	.53	1.00		
III	.51	.49	1.00	
IV	.30	.22	.44	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 36. **Factor Analysis of ASVAB and AFQT-7a Subtests for Form 8b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.58	.25	.22	−.01	3			
Arithmetic Reasoning (AR)	.18	.15	.66	.14			1	
Word Knowledge (WK)	.75	.10	.15	.12	1			
Paragraph Comprehension (PC)	.56	.17	.19	.16	4			
Numerical Operations (NO)	.10	.15	.20	.57				1
Coding Speed (CS)	.03	.25	.07	.57				2
Auto-Shop Information (AS)	.24	.73	−.02	.03		1		
Mathematics Knowledge (MK)	.10	.17	.57	.18			2	
Mechanical Comprehension (MC)	.16	.63	.24	.00		3		
Electronics Information (EI)	.41	.52	.09	.02	5	4		
Word Knowledge (WK-7a)	.74	.13	.13	.08	2			
Arithmetic Reasoning (AR-7a)	.25	.23	.55	.13			3	
Tool Knowledge (TK-7a)	.14	.68	.04	−.13		2		
Space Perception (SP-7a)	.08	.44	.35	−.04		5	4	

Correlation Matrix of Factors

I	1.00			
II	.53	1.00		
III	.51	.49	1.00	
IV	.30	.22	.44	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 37. **Factor Analysis of ASVAB and AFQT-7a Subtests for Form 9a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.61	.23	.23	−.01	3			
Arithmetic Reasoning (AR)	.19	.13	.64	.17			1	
Word Knowledge (WK)	.76	.12	.15	.09	1			
Paragraph Comprehension (PC)	.55	.16	.23	.14	4			
Numerical Operations (NO)	.09	.11	.17	.62				1
Coding Speed (CS)	.05	.24	.09	.58				2
Auto-Shop Information (AS)	.27	.71	.02	.01		1		
Mathematics Knowledge (MK)	.14	.11	.63	.14			2	
Mechanical Comprehension (MC)	.17	.53	.34	−.02		4	5	
Electronics Information (EI)	.33	.55	.12	.00	5	3		
Word Knowledge (WK-7a)	.72	.14	.10	.12	2			
Arithmetic Reasoning (AR-7a)	.24	.21	.50	.21			3	
Tool Knowledge (TK-7a)	.13	.68	.05	−.07		2		
Space Perception (SP-7a)	.07	.37	.41	.03		5	4	

Correlation Matrix of Factors

I	1.00			
II	.54	1.00		
III	.52	.49	1.00	
IV	.30	.23	.44	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 38. **Factor Analysis of ASVAB and AFQT-7a Subtests for Form 9b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.60	.31	.14	.05	4	6		
Arithmetic Reasoning (AR)	.22	.18	.61	.15			1	
Word Knowledge (WK)	.75	.15	.10	.12	1			
Paragraph Comprehension (PC)	.60	.15	.12	.18	3			
Numerical Operations (NO)	.14	−.01	.23	.61				2
Coding Speed (CS)	.06	.10	.09	.61				1
Auto-Shop Information (AS)	.23	.73	.04	.11		2		
Mathematics Knowledge (MK)	.18	.15	.58	.15			2	
Mechanical Comprehension (MC)	.14	.60	.29	.04		4		
Electronics Information (EI)	.33	.60	.01	.10	5	3		
Word Knowledge (WK-7a)	.73	.16	.09	.09	2			
Arithmetic Reasoning (AR-7a)	.27	.21	.52	.16			3	
Tool Knowledge (TK-7a)	.02	.74	.01	.05		1		
Space Perception (SP-7a)	.05	.46	.33	.08		5	4	

Correlation Matrix of Factors

I	1.00			
II	.50	1.00		
III	.46	.41	1.00	
IV	.42	.31	.50	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 39. **Factor Analysis of ASVAB and AFQT-7a Subtests for Form 10a**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.52	.22	.31	.02	4		6	
Arithmetic Reasoning (AR)	.22	.11	.61	.19			1	
Word Knowledge (WK)	.73	.12	.15	.12	1			
Paragraph Comprehension (PC)	.58	.16	.15	.19	3			
Numerical Operations (NO)	.04	.18	.17	.63				1
Coding Speed (CS)	.02	.31	.06	.59		5		2
Auto-Shop Information (AS)	.23	.72	.05	−.05		1		
Mathematics Knowledge (MK)	.20	.04	.56	.23			2	
Mechanical Comprehension (MC)	.19	.44	.44	−.04		4	5	
Electronics Information (EI)	.32	.55	.14	.02	5	3		
Word Knowledge (WK-7a)	.68	.21	.13	.07	2			
Arithmetic Reasoning (AR-7a)	.23	.18	.54	.20			3	
Tool Knowledge (TK-7a)	.05	.66	.19	−.17		2		
Space Perception (SP-7a)	.05	.30	.49	−.02		6	4	

Correlation Matrix of Factors

I	1.00			
II	.52	1.00		
III	.55	.54	1.00	
IV	.30	.20	.39	1.00

Note. — Only factor loadings ≥.30 are ranked.

Table 40. **Factor Analysis of ASVAB and AFQT-7a Subtests for Form 10b**
(Oblique Solution)

Subtests	Factor Loadings				Rankings			
	I	II	III	IV	I	II	III	IV
General Science (GS)	.57	.21	.27	.01	3			
Arithmetic Reasoning (AR)	.18	.14	.63	.19			1	
Word Knowledge (WK)	.76	.07	.16	.08	1			
Paragraph Comprehension (PC)	.55	.12	.23	.17	4			
Numerical Operations (NO)	.11	.17	.17	.60				1
Coding Speed (CS)	.07	.26	.09	.57				2
Auto-Shop Information (AS)	.31	.65	.01	−.02	6	2		
Mathematics Knowledge (MK)	.16	.11	.62	.17			2	
Mechanical Comprehension (MC)	.21	.49	.38	−.05		3	5	
Electronics Information (EI)	.39	.47	.13	.02	5	4		
Word Knowledge (WK-7a)	.74	.13	.12	.09	2			
Arithmetic Reasoning (AR-7a)	.26	.20	.51	.17			3	
Tool Knowledge (TK-7a)	.13	.67	.05	−.13		1		
Space Perception (SP-7a)	.06	.42	.40	−.04		5	4	

Correlation Matrix of Factors

I	1.00			
II	.54	1.00		
III	.55	.53	1.00	
IV	.30	.20	.42	1.00

Note. — Only factor loadings ≥.30 are ranked.

IV. CONCLUSIONS

Analyses were accomplished to evaluate the characteristics of ASVAB Forms 8a, 8b, 9a, 9b, 10a, and 10b. As a set, the data add evidence to support the argument that ASVAB Forms 8a through 10b are quite similar to each other in item characteristics as measured by both true score theory and IRT analyses.

The subtests are reasonably reliable, having coefficients of at least .80. Subtests are pitched toward the lower ability range with the exception of the quantitative tests.

Factor analysis was used to compare structure both within the new Forms and with previous ASVAB Forms. Factor analytic results are similar across the forms with a four-factor oblique solution appearing most interpretable for all forms. This factor structure is generally similar to structures obtained for previous ASVAB tests. This is both expected and reassuring.

REFERENCES

Birnbaum, A. Some latent-trait models and their use in inferring an examinee's ability. In F.M. Lord & M.R. Novick (Eds.), *Statistical theories of mental test scores.* Reading, MA: Addison-Wesley, 1968.

Cureton, E.E. Corrected item-test correlations, *Psychometrika*, 1966, **31**, 93-96.

Davis, F.B. Item selection techniques. In E.L. Lindquist (Ed.), *Educational measurement.* Washington, D.C.: American Council on Education, 1951.

Fischl, M.A., Ross, R.M., & McBride, J.R. *Development of factorially-based ASVAB high school composites.* Unpublished report. Alexandria, VA: U.S. Army Research Institute for The Behavioral and Social Sciences, 1977.

Fletcher, J., & Ree, M.J. *Armed Services Vocational Aptitude Battery (ASVAB) correlational analysis, ASVAB Form 2 versus ASVAB Form 5.* AFHRL-TR-76-70, AD-A032 593. Brooks AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, October 1976.

Gugel, J.F., Schmidt, F.L., & Urry, V.W. Effectiveness of the ancillary estimation procedure. In C.L. Clark (Ed.), *Proceedings of the first conference on Computerized Adaptive Testing.* Washington, D.C.: U.S. Civil Service Commission, 1976.

Gulliksen, H.O. *Theory of mental tests.* New York: Wiley, 1950.

Harris, C.W., & Kaiser, H.F. Oblique factor analytic solution by orthogonal transformations. *Psychometrika*, 1964, **29**, 347-362.

Henrysson, S. Gathering, analyzing, and using data on test items. In R.L. Thorndike (Ed.), *Educational measurement* (2nd ed.). Washington, D.C.: American Council on Education, 1971.

Kaiser, H.F. Varimax criterion for analytic rotation in factor analyses. *Psychometrika*, 1958, **23**, 187-200.

Lord, F., & Novick, M. *Statistical theories of mental test scores.* Reading, MA: Addison-Wesley, 1968.

Ree, M.J. Estimating item characteristic curves. *Applied Psychological Measurement*, 1979, **3**, 371-385.

Ree, M.J., Mathews, J.J., Mullins, C.J., & Massey, R.H. *Calibration of Armed Services Vocational Aptitude Battery Forms 8, 9, and 10.* AFHRL-TR-81-49. Brooks AFB, TX: Manpower and Personnel Division, Air Force Human Resources Laboratory. February 1982.

Sims, W.H., & Mifflin, T.L. *A factor analysis of the Armed Services Vocational Aptitude Battery (ASVAB) Forms 6 and 7.* (CNA)-78-3092. Arlington, VA: Center for Naval Analyses, 1978.